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Original Research Paper

Water Scarcity and Mental Well-Being in Bengaluru: A Multidimensional Study of Perceived Water Insecurity, Social Vulnerability, and Community Responses

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ABSTRACT

Water scarcity is an increasingly important urban challenge, with implications that extend beyond the availability of water for domestic use to the everyday experiences and well-being of individuals and communities. In rapidly urbanising cities such as Bengaluru, inconsistent water supply, dependence on alternative water sources, and concerns about water availability raise important questions about how residents experience and respond to water insecurity.

This study seeks to explore the relationship between water scarcity and mental well-being among Bengaluru residents, with particular attention to perceived water stress, socioeconomic differences, community coping mechanisms, and public policy responses. The study adopts a multidimensional approach to understanding how water-related challenges may influence daily routines, emotional experiences, household responsibilities, and perceptions of security. It also considers the potential role of community participation, social support, equitable access to water, and institutional responsiveness in addressing these concerns.

By examining water scarcity through both environmental and psychosocial perspectives, the research aims to contribute to a broader understanding of urban water security and its human dimensions. The study further seeks to inform policies and community-based initiatives that recognise the importance of reliable water access, sustainable resource management, and mental well-being in building resilient and inclusive urban communities.

Keywords: water scarcity, mental well-being, water insecurity, Bengaluru, community resilience, socioeconomic vulnerability, urban water governance

Introduction

Reliable access to water is central to health, hygiene, household functioning, and dignity. When supply is uncertain, households may have to reorganise daily routines, purchase water, monitor storage, negotiate shared resources, or reduce water use for cleaning and other activities. These demands can create emotional strain even where the immediate problem is framed as a service-delivery or resource-management issue. International evidence increasingly recognises that water insecurity and inadequate sanitation are associated with psychological distress and common mental-disorder symptoms, although effect sizes and pathways vary across settings (Kimutai et al., 2023; Wutich et al., 2020).

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Water insecurity is broader than absolute scarcity. It can include unreliable supply, unaffordability, concerns about quality, inadequate infrastructure, and unequal ability to secure water. Such conditions may generate financial pressure, time costs, social conflict, shame, worry, and a reduced sense of control. A systematic review and meta-analysis by Kimutai et al. (2023), covering 25 studies and 23,103 participants across 16 countries, reported a significant association between water insecurity and symptoms of common mental disorders. The authors also cautioned that much of the evidence was cross-sectional, limiting causal inference.

In urban settings, the experience of water insecurity is shaped by the interaction of public supply, groundwater extraction, household storage, tanker markets, building design, and the capacity of local institutions. The same citywide stressor may therefore be experienced differently across households. Residents with financial resources or storage infrastructure may be better able to buffer short interruptions, while others may have fewer practical options. Gendered household responsibilities may also influence who bears the time and emotional costs of securing water. These mechanisms are plausible and important to investigate, but they should not be assumed to operate identically in every household.

The present study shall use survey responses collected in Bengaluru to describe how respondents perceived water insecurity, how they believed it affected daily and emotional life, and what they expected from communities and government.

Literature Review

Water insecurity and psychological distress

Research on water and mental health suggests that the psychological effects of insecure access can arise through several connected pathways. Repeated uncertainty about meeting basic needs may sustain worry; purchasing or arranging water may impose financial and logistical burdens; and inability to maintain expected standards of hygiene can affect dignity and social participation. Wutich et al. (2020) reviewed evidence from multiple disciplines and argued that water insecurity is a plausible contributor to mental ill-health, while noting that this relationship has historically received less attention than the physical-health consequences of unsafe water.

The systematic review by Kimutai et al. (2023) provides stronger quantitative synthesis: across the included studies, water insecurity was associated with poorer mental-health outcomes.

Why Mental Health Must Be a Major Concern During Water Scarcity

Water scarcity is not merely an environmental, infrastructural, or economic problem; it is also a public mental health concern. Uncertain access to sufficient and safe water can affect people's sense of security, dignity, control, and emotional well-being. Research increasingly recognises that water insecurity is associated with psychological distress and symptoms of common mental disorders, including anxiety and depression (Kimutai et al., 2023; Wutich et al., 2020). When people are unsure whether they will have enough water for drinking, cooking, bathing, cleaning, and other essential daily activities, they may experience persistent stress, anxiety, anger, frustration, sadness, and helplessness. Households may have to reorganise daily routines, spend additional money on tanker water, wait for deliveries, or make difficult decisions about how limited supplies should be used. Such circumstances may create uncertainty, financial pressure, and a diminished sense of control. Wutich et al. (2020) identified several possible pathways connecting water insecurity with mental ill-health, including material deprivation, uncertainty, shame, health-related worries, restricted autonomy, interpersonal conflict, and perceived institutional injustice. A systematic review by Kimutai et al. (2023), which synthesised 25 studies involving 23,103 participants across 16 countries, also found an association between water insecurity and symptoms of common mental disorders. However, much of the available evidence is cross-sectional, so causal relationships cannot always be established.

The psychological burden may be distributed unequally across society. Women and household members responsible for managing water may face additional pressures when they must secure supplies while meeting household needs. Research in two water-insecure urban communities in New Delhi documented concerns relating to stress, frustration, anger, dignity, and menstrual hygiene among women living with inadequate water access (Choudhary et al., 2023). These findings highlight the importance of considering gender roles, household responsibilities, affordability, and access inequalities when assessing the mental-health consequences of water scarcity.

The implications extend beyond immediate emotional distress. If water insecurity persists, repeated worry and disruption may affect daily functioning, relationships, productivity, and perceived well-being. These are plausible long-term pathways, but their extent and duration need to be examined through longitudinal research rather than assumed from cross-sectional findings (Kimutai et al., 2023; Wutich et al., 2020). Households with limited financial resources or unreliable municipal water access may have fewer options for coping with shortages, making equity an essential consideration in water policy.

Mental health must therefore be recognised as an integral component of water security, rather than a secondary concern to be addressed only after a crisis.

Water-management strategies should consider not only the quantity, quality, affordability, and reliability of water, but also the psychological and social consequences of unreliable access. Transparent communication about supply, equitable distribution, affordable alternatives, community participation, timely grievance redressal, and appropriate psychosocial support may help reduce uncertainty and strengthen residents' sense of control. Researchers have also argued that water-security assessments should capture people's lived experiences of access, adequacy, reliability, and safety rather than relying exclusively on broad supply indicators (Young et al., 2019).

Ultimately, a water-secure city must also consider the psychological security of its residents. Recognising the mental-health dimension of water scarcity can help policymakers develop more humane, equitable, and responsive interventions. Protecting access to water means protecting not only physical health and daily functioning, but also dignity, peace of mind, and people's capacity to live with security and confidence.

Social vulnerability and unequal coping capacity

Water insecurity is experienced within household and neighbourhood contexts. Income, tenure, residence type, access to municipal connections, groundwater availability, and the ability to pay for tanker deliveries may shape exposure and coping choices. Global monitoring has repeatedly highlighted inequalities in access to safely managed drinking water and sanitation (World Health Organization & United Nations Children's Fund, 2019). In a city-level study, these factors should be measured directly rather than inferred from respondents' opinions about which groups are more affected.

Gender is another relevant dimension. Where household water management and care work are unevenly distributed, water insecurity may add time pressure and emotional labour. Nevertheless, a survey item asking whether women experience more stress measures respondents' beliefs, not a direct comparison of women's and men's mental-health outcomes. The distinction is essential when interpreting the present data.

Community resilience and governance

Neighbourhood networks can share information, coordinate conservation, maintain rainwater-harvesting systems, and advocate for improved services. Yet collective action may be constrained by unequal resources, competing priorities, or the belief that responsibility lies primarily with public authorities. Water governance therefore needs both reliable infrastructure and transparent communication, meaningful citizen participation, and attention to affordability and distributional fairness. The current study shall examine respondents' reported perceptions of community action and policy implementation, rather than independently auditing the performance of government programmes.

Objectives of the Study

1. Perceived Water Stress (PWS): To examine residents' perceptions of water scarcity and its effects on daily life, stress, and coping strategies.
2. Socioeconomic Disparities (SED): To explore perceived differences in the impact of water scarcity across gender, age, income, education, lifestyle, and housing conditions.
3. Community Resilience (CR): To assess the role of community support, social cohesion, and collective action in addressing water scarcity and its associated psychological burden.
4. Policy and Governance Interventions (PGI): To examine residents' perceptions of water-management policies, equitable access, and government responses to water scarcity and mental well-being.

Method

Study Design and Setting

This was a cross-sectional questionnaire study focused on residents reporting a connection to Bengaluru. The supplied research document described a multidimensional approach and the spreadsheet contained responses recorded between 2nd to 25th March 2026.

The study employed a researcher-designed structured questionnaire containing categorical items, a single five-point ordinal item assessing perceived water-scarcity severity, and open-ended questions concerning respondents' experiences and perceptions. The questionnaire is not a validated clinical mental-health instrument and it does not diagnose anxiety or depression. The questionnaire was based on an abridged version of a validated scale of multi-item household water-insecurity measures, like the HWISE Scale, the PHQ-9 and GAD-7. Consequently, the findings are interpreted as a description of perceived water insecurity and self-reported emotional experiences rather than as estimates of clinical mental-health conditions.

Some questions in the questionnaire were structured questions including Likert-type items to respond and some were open-ended questions, which were coded and analysed. The sample comprised respondents from Bengaluru. The questionnaire was circulated through social media platforms The survey was floated on social media platforms with their consent and assurance of confidentiality.

Participants and Data

The spreadsheet contained 52 submitted records. One record lacked the age variable and was largely incomplete across the questionnaire; it was excluded from the primary descriptive dataset. The resulting analysis dataset contained 51 respondents. The

spreadsheet included demographic categories, reported water sources, perceived severity, tanker purchasing, water-related daily-life and emotional effects, perceptions of social vulnerability, community responses, and views on policy.

Measures

The questionnaire included a five-point item asking respondents to rate the severity of the water problem in their area; yes/no or categorical items about whether water insecurity affected them and whether effects were physical, psychological, or both; an open-ended item on mental-health impacts; questions about perceived gender, age, income/affluence, education, and access-related differences; and questions about community action and government policy.

Data Analysis

The spreadsheet was inspected and analysed using descriptive counts and percentages. Percentages are calculated against the 51-person primary dataset unless an item-specific denominator is stated. Responses to open-ended questions were reviewed descriptively to identify recurring topics, including worry or stress, anger or frustration, tanker dependence, conservation and rainwater harvesting, and calls for stronger governance.

Results

Respondent Profile and Perceived Severity

The data collected therefore leaned toward middle-aged and highly educated respondents and should not be assumed to reflect Bengaluru's demographic profile.

Table 1. Demographic Characteristics of Survey Respondents

Characteristic	n	% of 51
Age 15–22 years	3	5.9
Age 22–40 years	18	35.3
Age 40–60 years	28	54.9
Age 60 years and above	2	3.9
Female	19	37.3
Male	32	62.7
Postgraduate degree or above	27	52.9
Graduation	19	37.3

Objective 1 Perceived Water Stress (PWS)

Forty-six respondents reported that water insecurity affected them (90.2% of the primary dataset); five answered no. When asked about daily life, 42 reported effects on both physical and mental well-being (82.4%), seven reported effects on mental well-being (13.7%), and two reported effects on physical well-being (3.9%). These answers indicate that respondents commonly perceived water insecurity as extending beyond physical inconvenience.

Thirty-three respondents reported buying tanker water (64.7%); 18 reported that they did not, with one response missing. Among those who answered the follow-up on tanker frequency, the most frequently recorded answer was 'Thrice' (18 respondents), followed by 'Once' (10) and 'Twice' (5). The question wording refers to a 15-day period, but it is unclear whether all respondents interpreted the frequency options consistently.

Figure 1. Perceived Water Stress (PWS)

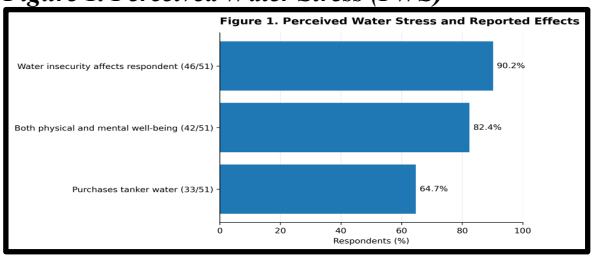


Table 2. Reported Effects of Water Insecurity on Respondents' Daily Well-Being and Tanker-Water Use Frequency and percentage distribution

Variable	Response	Frequency	% of valid N
Water Scarcity Severity (1–5)	1	6	11.76%
Water Scarcity Severity (1–5)	2	9	17.65%
Water Scarcity Severity (1–5)	3	11	21.57%
Water Scarcity Severity (1–5)	4	16	31.37%
Water Scarcity Severity (1–5)	5	9	17.65%
Tanker Buying	No	18	35.29%
Tanker Buying	Yes	33	64.71%
Water Insecurity Affects	No	5	9.80%

Water Insecurity Affects	Yes	46	90.20%

Table 3. Descriptive Statistics of Perceived Water Scarcity and Household Water Insecurity

Variable	Valid N	Mean	Median	Mode	SD
Water Scarcity Severity (1–5)	51	3.2549	3	4	1.2782
Tanker Buying	51	0.6471	1	1	0.4826
Water Insecurity Affects	51	0.9020	1	1	0.3003

Emotional Responses and Coping

Open-ended responses included references to stress, anxiety, uncertainty about future supply, frustration, anger, sadness, helplessness, concerns about hygiene, and loss of time or productivity. Some respondents described feeling unable to influence the wider water situation, while others referred to practical adjustments such as conserving water, reusing treated water, or relying on tanker deliveries.

Perceptions of Social Vulnerability

Forty-six respondents (90.2%) believed women experience greater mental stress due to water scarcity. Forty-one (80.4%) believed people in their own age group experience a greater impact, and 42 (82.4%) believed people without access to municipal water experience greater mental-health impacts. Thirty-three respondents (64.7%) believed people with less education experience greater stress, while opinions about affluent lifestyles were more divided: 27 respondents answered no and 24 answered yes to the proposition that affluent people experience less mental-health impact. Water Scarcity Severity: mean severity = 3.25 on the 1–5 scale; the most frequent rating was 4 of the 16 respondents, 31.37%. Tanker Buying: No: 18 (35.29%); Yes: 33 (64.71%). Water Insecurity Affects: No: 5 (9.80%); Yes: 46 (90.20%).

Objective 2 Socioeconomic Disparities (SED)

Figure 2. Respondents' Perceptions of Social Vulnerability to Water Scarcity by Gender, Age, Education, and Socioeconomic Status

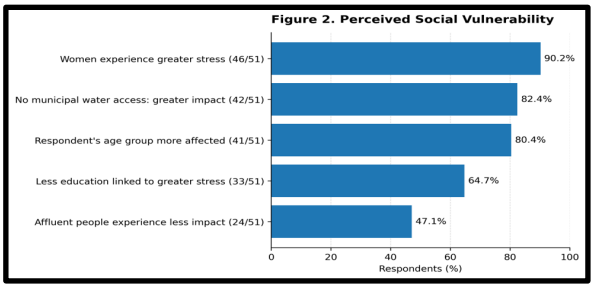


Table 4. Respondents' Perceptions of Social and Socioeconomic Vulnerability to Water Scarcity

Variable	Valid N	Mean	Median	Mode	SD
Women More Stress	51	0.9020	1	1	0.3003
Age More Impact	51	0.8039	1	1	0.4010
No Municipal Access More Impact	51	0.8235	1	1	0.3850
Affluent Less Impact	51	0.4706	0	0	0.5041
Lower Education More Stress	51	0.6471	1	1	0.4826

Table 5. Frequency and Percentage Distribution of Respondents' Perceptions of Social and Socioeconomic Vulnerability to Water Scarcity

Variable	Response	Frequency	% of valid N
Women More Stress	No	5	9.80%
Women More Stress	Yes	46	90.20%
Age More Impact	No	10	19.61%
Age More Impact	Yes	41	80.39%
No Municipal Access More Impact	No	9	17.65%

No Municipal Access More Impact	Yes	42	82.35%
Affluent Less Impact	No	27	52.94%
Affluent Less Impact	Yes	24	47.06%
Lower Education More Stress	No	18	35.29%
Lower Education More Stress	Yes	33	64.71%

Community Action and Governance

Thirty-three respondents said their neighbours shared similar water-shortage concerns, 13 answered 'maybe', and five answered no; one response was missing. On whether community action had been taken to mitigate water problems, 17 answered yes, 31 answered no. Free-text examples of actions included rainwater harvesting, borewell recharge, reducing wastage, using treated wastewater for non-potable purposes, and communicating conservation practices.

Forty respondents (78.4%) said the government should consider residents' mental well-being when addressing water crises; nine selected maybe and two selected no. Twenty-two respondents believed the government did not consider the mental-health impact, 17 answered maybe, and 12 answered yes. Thirty-nine respondents (76.5%) judged water-policy implementation to be inadequate, compared with 12 who judged it adequate.

Objective 3 Community Resilience (CR)

Figure 3. Perceived Neighbourhood-Level Water Insecurity and Community Action in Response to Water Scarcity

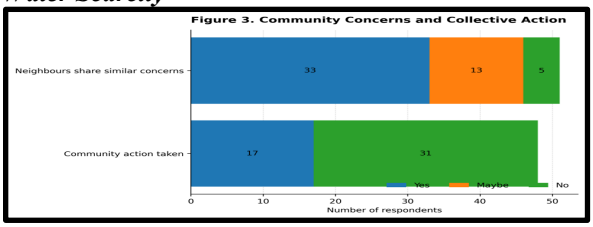


Table 6. Neighbourhood-Level Experiences and Community Responses to Water Scarcity

Variable	Valid N	Mean	Median	Mode	SD
Neighbours Affected	51	1.1569	1	1	0.5787
Community Action	48	0.3542	0	0	0.4833

Table 7. Frequency and Percentage Distribution of Respondents' Perceptions of Community Responses to Water Scarcity

Variable	Response	Frequency	% of valid N
Neighbours Affected	No	5	9.80%
Neighbours Affected	Yes	33	64.71 %
Neighbours Affected	Maybe/uncertain	13	25.49 %
Community Action	No	31	64.58 %
Community Action	Yes	17	35.42 %
Community Action	Missing	3	—

Interpretation:

Neighbours Affected: 33 respondents (64.71%) answered Yes, 5 (9.80%) No, and 13 (25.49%) Maybe/uncertain.

Community Action: 17 of 48 valid respondents (35.42%) reported community action; 31 (64.58%) did not.

Missing responses: 3; missing values were excluded, not coded as zero.

Objective 4 Policy and Governance Interventions (PGI)

Figure 4. Respondents' Perceptions of Government Recognition of Mental Well-Being and the Adequacy of Water Policy Implementation

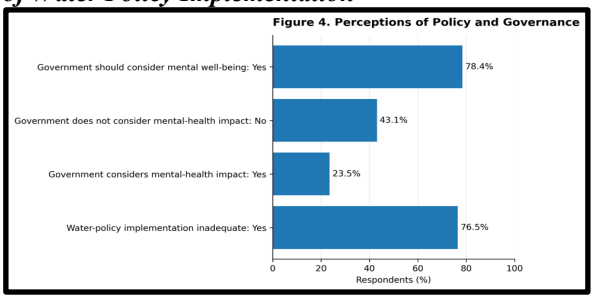


Table 8. Responses Perceptions of Government Responsiveness and Water Policy Implementation.

Variable	Valid N	Mean	Median	Mode	SD
Government Should Consider Mental Well-being	51	1.1373	1	1	0.4481

Government Recognises Mental Impact	51	0.9020	1	0	0.8776
Policy Implemented Properly	51	0.2353	0	0	0.4284

Table 9. Respondents' Frequency and percentage distribution Perceptions of Government Responsiveness and Water Policy Implementation.

Variable	Response	Frequency	% of valid N
Government Should Consider Mental Well-being	No	2	3.92%
Government Should Consider Mental Well-being	Yes	40	78.43 %
Government Should Consider Mental Well-being	Maybe/uncertain	9	17.65 %
Government Recognises Mental Impact	No	22	43.14 %
Government Recognises Mental Impact	Yes	12	23.53 %
Government Recognises Mental Impact	Maybe/uncertain	17	33.33 %
Policy Implemented Properly	No	39	76.47 %
Policy Implemented Properly	Yes	12	23.53 %

Interpretation:

Government Should Consider Mental Well-being: No: 2 (3.92%); Yes: 40 (78.43%); Maybe/uncertain: 9 (17.65%).

Government Recognises Mental Impact: No: 22 (43.14%); Yes: 12 (23.53%); Maybe/uncertain: 17 (33.33%).

Policy Implemented Properly: No: 39 (76.47%); Yes: 12 (23.53%).

Water-scarcity severity and tanker-water purchasing

There was a moderate positive association between perceived water-scarcity severity and tanker-water purchasing (Spearman's $\rho = 0.557$, $p < .001$; bootstrap 95% confidence interval [0.317, 0.749]). Respondents who reported buying tanker water had a higher median severity rating (median = 4) than those who did not report buying tanker water (median = 2). The Mann–Whitney comparison was also statistically significant ($U = 491.5$, $p < .001$).

This finding suggests that households reporting more severe water scarcity were also more likely to rely on tanker purchases. It is consistent with the possibility that alternative water procurement becomes more necessary as perceived scarcity increases. However, the analysis does not show that severity causes tanker purchasing, nor does it quantify the financial burden of those purchases.

Table 10. Association between perceived water-scarcity severity and tanker-water purchasing

Tanker-water purchasing	n	Median severity (1–5)	IQR (severity)
Yes	33	4	3.0–4.0
No	18	2	1.2–3.0

Association test: Spearman's $\rho = 0.557$, $p < .001$, bootstrap 95% CI [0.317, 0.749].

Water-scarcity severity and reported personal impact

The association between perceived severity and whether respondents reported that water insecurity affected them was positive but not statistically significant (Spearman's $\rho = 0.226$, $p = 0.111$; bootstrap 95% confidence interval [-0.025, 0.436]). Respondents answering Yes had a median severity rating of 4, compared with 2 among those answering No. The Mann–Whitney test was also not statistically significant ($U = 164.0$, $p = 0.114$).

Although the median severity was higher among respondents reporting an impact, only five participants answered No to the impact question. This highly

uneven group size limits the precision and statistical power of the comparison. The result should therefore not be interpreted as evidence that severity and reported impact are unrelated; rather, this sample does not provide sufficient statistical evidence of an association.

Table 11. Association between perceived water-scarcity severity and reported personal impact

Water insecurity affects respondent	n	Median severity (1–5)	IQR (severity)
Yes	46	4	2.2–4.0
No	5	2	2.0–3.0

Association test: Spearman's ρ = 0.226, p = 0.111, bootstrap 95% CI [-0.025, 0.436].

Neighbourhood concerns and community action

Neighbourhood concern category was associated with reported community action (3 × 2 Monte Carlo exact test, p = 0.020; Cramér's V = 0.400; valid n = 48). Among respondents who said neighbours were also affected, 15 of 30 (50.0%) reported community action. In comparison, 1 of 5 (20.0%) respondents who said No and 1 of 13 (7.7%) who answered Maybe/uncertain reported community action.

The pattern suggests that clear recognition of shared neighbourhood concerns may coincide with greater reported collective action. However, the small numbers in the No and Maybe/uncertain groups require caution. The association does not establish that shared concerns lead to collective action; organised action may also influence how residents perceive and discuss a shared problem.

Table 12. Neighbourhood concerns by reported community action

Neighbourhood concern	Community action: Yes, n (%)	Community action: No, n (%)	Total n	Action rate
No	1 (20.0%)	4 (80.0%)	5	20.0 %
Yes	15 (50.0%)	15 (50.0%)	30	50.0 %
Maybe/uncertain	1 (7.7%)	12 (92.3%)	13	7.7%

Monte Carlo exact test (200,000 tables): p = 0.020; Cramér's V = 0.400. Three community-action responses were missing; valid n = 48.

Table 13. Reported concerns and indicative impact ratings

Reported issue/theme	Count (% of 50 valid responses)	Interpretation	Indicative impact
Anger	21 (42.0%)	Irritation or anger linked to repeated inconvenience, shortages, or perceived lack of accountability.	4/5 — High
Stress	20 (40.0%)	Emotional pressure from planning water use, arranging supplies, and managing household needs.	5/5 — Very high
Anxiety or worry	14 (28.0%) under anxiety/worry code; one additional response under a separate anxiety code	Concern about future availability, expenses, hygiene, and meeting household needs.	5/5 — Very high
Time/routine disruption	11 (22.0%)	Lost time, interrupted activities,	4/5 — High

		and reduced productivity while arranging water.	
Sadness	10 (20.0%)	Distress, disappointment, or discouragement associated with recurring shortages.	3/5 — Moderate
Guilt	6 (12.0%)	Possible guilt about water use, household needs, conservation, or coping with shortages.	3/5 — Moderate
Shame	6 (12.0%)	Possible embarrassment or reduced dignity when basic hygiene and household needs are difficult to meet.	3/5 — Moderate
Depression-related wording	3 (6.0%)	Responses coded under sadness/depression; this does not establish clinical depression.	4/5 — High
Hygiene concerns	2 (4.0%)	Worry about cleanliness, washing, sanitation, and acceptable living conditions.	4/5 — High
Helplessness/powerlessness	One response in each of two related coding categories	Feeling unable to influence water supply or institutional decisions.	4/5 — High

Interpretation

The findings indicate that water insecurity may extend beyond the immediate challenge of obtaining water to affect emotional well-being, household functioning, dignity, and perceived control. Anger and stress were the most frequently identified emotional themes, followed by anxiety or worry and sadness. Respondents also described disruption to daily routines and concerns about hygiene and their ability to influence the situation.

If water insecurity continues over time, these pressures may accumulate, particularly among households with limited financial resources or unreliable access to municipal water. Responsibilities associated with securing water may also disproportionately affect women and other household members responsible for daily water management. These longer-term pathways require further investigation.

Discussion

The findings of this study indicate that water insecurity is experienced not simply as an interruption in water supply, but as a practical and social challenge that households must continually manage. Among the 51 respondents, the mean perceived water-scarcity severity was 3.25 on a five-point scale, and approximately 49% rated severity at 4 or 5. Nearly two-thirds (64.7%) reported purchasing tanker water, while 90.2% said that water insecurity affected them. These responses suggest that many participants had to make additional arrangements to meet their household water needs. Such arrangements can involve planning, uncertainty and extra effort, although the present survey did not directly quantify the financial cost or time spent obtaining water.

The association analysis adds an important dimension to this finding. Perceived water-scarcity severity was positively associated with tanker-water purchasing (Spearman's $\rho = 0.557$, $p < .001$; bootstrap 95% CI [0.317, 0.749]). Respondents who purchased tanker water reported a higher median severity rating (4) than those who did not (2). This pattern is consistent with the possibility that households experiencing greater scarcity are more likely to turn to alternative sources. However, the analysis is correlational: it does not establish that greater severity causes tanker purchasing, and it does not show how affordable or burdensome these purchases were for individual households.

The relationship between perceived severity and the report that water insecurity affected the respondent was positive but did not reach statistical significance (Spearman's $\rho = 0.226$, $p = .111$; bootstrap 95% CI [−0.025, 0.436]). Although respondents who reported being affected had a higher median severity rating (4) than those who did not (2), only five participants selected "No". The small and uneven comparison groups limit the precision of this estimate. This result should therefore be interpreted as inconclusive rather than as evidence that severity and personal impact are unrelated. It also illustrates why both the size of an observed difference and the uncertainty around it matter when interpreting a small sample.

Respondents also perceived water insecurity as socially unequal. A large majority believed that women experience greater stress (90.2%), while 82.4% identified people without municipal water access as more affected. Around 80.4% considered age an important factor, and 64.7% believed that people with lower levels of education experience greater stress. These findings describe participants' views about vulnerability; they do not demonstrate that women, older people or people with less education in this sample experienced higher measured stress. Nevertheless, the responses draw attention to the ways that access to services, household roles and personal resources may shape how water shortages are managed. Views on whether affluent people experience less impact were more divided, suggesting that respondents did not share a single view about the protective role of financial resources.

At the neighbourhood level, the analysis found an association between whether respondents perceived their neighbours to be affected and whether they reported community action (3 × 2 Monte Carlo exact test, $p = .020$; Cramér's $V = 0.400$; valid $n = 48$). Half of those who said their neighbours were also affected reported community action (15 of 30), compared with one of five respondents who said No (20.0%) and one of 13 who answered Maybe/uncertain (7.7%). This pattern suggests that clearly recognising a shared problem may coincide with greater reported collective activity. The smaller numbers in the No and Maybe/uncertain groups require caution, and the association does not show that shared concern necessarily produces action. Community activity may also shape how residents recognise and discuss a common water problem.

The descriptive findings also point to a gap between what respondents expect from water governance and what they believe is currently recognised. While 78.4% felt that the government should consider mental well-being in water policy, only 23.5% believed that the government recognises the mental-health impact of water scarcity. A further 43.1% felt that it does not, while 33.3% were uncertain. In addition, 76.5% considered water-policy implementation inadequate. These are perceptions rather than an independent audit of government performance, but they indicate that many respondents want water management to pay attention to the human consequences of shortages, alongside supply, quality and infrastructure.

The emotional responses provide further insight into this human dimension. Participants described experiences such as anger, stress, anxiety and frustration, alongside changes to routines and efforts to manage limited supplies. These responses should be understood as self-reported emotional experiences, not as clinical diagnoses or measured levels of psychological disorder. They nevertheless show why the experience of water insecurity cannot be fully described through supply figures alone. For a household, the difficulty may lie not only in the absence of water, but also in repeatedly having to plan, arrange, conserve and adjust everyday activities around uncertain availability.

Taken together, the findings suggest that perceived water insecurity in this sample involved several connected dimensions: severity of shortage, reliance on alternative water sources, perceived social vulnerability, neighbourhood experiences and expectations of public institutions. The additional association tests strengthen the analysis by showing that tanker purchasing varied with perceived severity and that neighbourhood concern was associated with reported community action. The study is cross-sectional, based on self-reported responses and does not establish causal effects or represent all households in Bengaluru.

The wider implication is that urban water security should be understood from the perspective of the people who experience it. Reliable and affordable access remains essential, but so do clear communication, fair distribution, meaningful community participation and attention to the practical and emotional work involved in managing shortages. Water security is not only about whether water reaches

a household; it is also about whether people can depend on that supply without having to carry an excessive burden of uncertainty, time, effort or expense.

Table 14. Potential long-term impacts of persistent water insecurity

Area	**Possible long-term consequences**	**Potential concern**
Chronic psychological stress	Repeated uncertainty may sustain emotional strain and reduce perceived control.	High
Persistent anxiety and worry	Anticipating shortages, costs, and household difficulties may make it harder to relax and feel secure.	High
Sleep and concentration	Ongoing worry and time spent arranging supplies may interfere with rest, attention, and daily functioning.	Moderate–High
Emotional exhaustion	Repeated frustration, anger, and powerlessness may reduce coping capacity and resilience.	High
Family and interpersonal relationships	Competition over limited water, household responsibilities, and financial pressures may contribute to tension.	Moderate–High
Women's workload and well-being	Where women carry more water-management responsibilities, added work may reduce time for rest, education, or employment.	High
Financial insecurity	Repeated tanker-water purchases may create pressure, especially for households with fewer resources.	High
Hygiene, dignity, and social participation	Difficulty maintaining hygiene may cause embarrassment, restrict activities, and undermine dignity.	Moderate–High
Work and education	Time spent arranging water may reduce productivity, interrupt study, and disrupt schedules.	Moderate–High
Trust in institutions	Perceptions that policies are ineffective or concerns are ignored may weaken confidence in institutions.	Moderate–High

Long-term mental well-being	Without adequate support, some people may experience sustained distress or require professional support.	High

Limitations

This study has certain limitations that should be considered when interpreting its findings. The analysis is based on a relatively small sample of 51 respondents and may not fully represent the experiences of all households in Bengaluru. Since the study follows a cross-sectional approach, it captures participants' experiences and perceptions at a particular point in time and cannot establish whether water scarcity directly causes psychological distress. The findings are also based largely on self-reported responses, which may reflect individual experiences and perceptions. Furthermore, the study explores perceived social vulnerability and emotional implications rather than using clinical assessments to measure mental-health conditions. Despite these limitations, the study offers useful preliminary insights into the human and social dimensions of urban water insecurity and highlights the need for larger, more diverse and longitudinal studies to understand these experiences in greater depth.

Recommendations

Priority	Recommendation	Evidence connection
1. Secure reliable and affordable household water access	Urban water authorities and local governments should strengthen the reliability, continuity and affordability of household water services. This should include transparent supply schedules, timely communication of interruptions, prompt repair of distribution failures, monitoring of water quality, and accessible emergency arrangements. Where tanker supply is required, authorities should ensure that it is safe, fairly allocated and reasonably priced, with particular attention to households that cannot readily absorb additional costs.	The study found a moderate positive association between perceived water-scarcity severity and tanker-water purchasing (Spearman's $\rho = 0.557$, $p < .001$). This indicates that respondents reporting greater scarcity were also more likely to report purchasing tanker water. The finding supports attention to the financial and practical consequences of unreliable supply; it does not establish that scarcity caused tanker purchasing.
2. Incorporate psychosocial well-being into water-security assessment	Urban water-security monitoring should extend beyond infrastructure coverage and aggregate supply indicators to include household-level experiences of reliability, affordability, time spent securing water, disruption to domestic routines and self-reported emotional strain. Local authorities should consider adding brief,	Most respondents (78.4%) considered mental well-being an issue that the government should take into account in water policy. Open-ended responses also described experiences including stress, anxiety, anger and frustration. These self-reported experiences support the

	clearly defined psychosocial and lived-experience indicators to periodic community assessments. Such indicators should be used to identify service-related burdens, not to diagnose mental-health conditions unless validated clinical instruments are separately administered by appropriately qualified personnel.	relevance of psychosocial considerations, while not constituting clinical measures of anxiety or depression.
3. Institutionalise neighbourhood participation and collective response	Urban local bodies and water agencies should establish accessible mechanisms through which resident associations, community organisations and neighbourhood groups can report shortages, identify service gaps and participate in local water planning. Community-led initiatives—including rainwater harvesting, water conservation, groundwater recharge, wastewater reuse and restoration of local water bodies—should be supported through technical guidance and coordination with relevant agencies. Community participation must complement, and not substitute for, the public responsibility to ensure equitable access to safe water.	Perceived neighbourhood concern was associated with reported community action in the complete-case analysis (Cramér's V = 0.400, Monte Carlo exact p = .020; n = 48). This association suggests a relationship between recognition of a shared concern and reported action. The small subgroup sizes and cross-sectional design mean that the result should be interpreted cautiously and not as evidence that concern necessarily produces collective action.
4. Address unequal exposure and household water-management burdens	Water policies and emergency-response arrangements should be designed to account for differences in household resources, access and capacity to cope with interruptions. Consultation and planning should include women, older adults, people with disabilities, low-income households and residents in areas with limited municipal access.	Respondents perceived women, older people, people without municipal water access and those with lower educational attainment as potentially more affected by water scarcity. These findings describe perceived vulnerability rather than directly measured differences in stress or exposure between

	Authorities should assess who is responsible for collecting, storing and managing household water, and ensure that service arrangements do not deepen existing inequalities or transfer the burden of unreliable supply to households.	demographic groups. They nevertheless identify groups and household responsibilities that merit more focused investigation and inclusive planning.
5. Strengthen public communication, institutional coordination and accountability	Water utilities and urban local bodies should provide timely, consistent and accessible information about supply schedules, interruptions, water quality and alternative arrangements. They should maintain transparent grievance-redressal systems, communicate expected restoration times where possible, and publish clear responses to recurring service problems. Coordination among water utilities, municipal authorities, groundwater agencies, public-health services and lake or catchment-management institutions should be strengthened so that household concerns are addressed across institutional responsibilities.	Although 78.4% of respondents felt that government should consider mental well-being in water policy, 23.5% believed that government recognises the mental-health impacts of water scarcity, while 76.5% considered policy implementation inadequate. These figures reflect respondents' perceptions and should not be interpreted as an independent audit of government recognition or implementation.
6. Integrate ecosystem-based water management and strengthen the evidence base	Urban water planning should protect and restore lakes, wetlands, catchments and groundwater systems as part of a broader portfolio of water-security measures. Rainwater harvesting, groundwater recharge, responsible wastewater reuse and demand management should be planned in coordination with local hydrological conditions and long-term maintenance requirements. Future studies should recruit larger and more diverse samples, use clearly	Open-ended responses identified rainwater harvesting, waterbody restoration, groundwater management and water conservation among suggested responses. The sample of 51 respondents also demonstrates the need for larger studies before drawing population-level conclusions. The present survey did not evaluate the effectiveness of ecosystem-restoration or other water-

	specified measures of household water insecurity, and employ validated psychological instruments when assessing clinical symptoms. Longitudinal and seasonally repeated research would help establish how household experiences vary with the duration and intensity of water interruptions.	management interventions.

Conclusion

This study highlights that water insecurity in Bengaluru is not merely a question of water availability but also a concern for people's everyday functioning and psychological well-being. The survey findings revealed that respondents reported emotional experiences such as stress, anxiety or worry, anger, sadness, and helplessness, alongside concerns about hygiene and disruptions to daily routines. These findings underline the importance of viewing water scarcity through a human-centred perspective that recognises the connections between reliable water access, dignity, social vulnerability, and quality of life. Although the cross-sectional design does not establish causal relationships or clinical mental-health outcomes, it provides a useful basis for further investigation. Addressing water insecurity therefore requires more than infrastructure and conservation measures; it calls for equitable water distribution, transparent governance, community participation, and greater consideration of mental well-being in water-management policies. Ultimately, sustainable urban water security must protect not only the resource itself but also the well-being of the communities that depend on it.

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